Applicants request reconsideration of the application in view of the remarks appearing below herein.

Remarks

Claims 1 - 10 remain in the application.

I. THE ART REJECTIONS

1. Claims 1, 3, 6 and 8 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,240,217 B1 ("Ercan et al") in view of U.S. Patent 6,396,539 B1 ("Heller et al"). In support of the rejection, the examiner has generally asserted that steps (a) and (b) of present claim 1 are obvious since Ercan et al relates to digital image processing and, further, that although the primary reference does not explicitly specify recovering missing information, Heller et al teaches that compensation pixel values are generated to replace missing data from defective pixels.

2. Claims 2 and 7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Ercan et al in view of United States Patent Application Publication No. US2002/0081019 A1 ("Katayama et al"). In support of the rejection the examiner has generally asserted that although Ercan et al does not specify pattern-wise arrangement of image sensors, Katayama et al does teach providing an image sensing apparatus which determines whether the optimum image sensing conditions are achieved

or not by judging whether there is a predetermined pattern in an image sensing field.

These art rejections are identical to those made in the first Office Action mailed April 9, 2003 in the application. Applicants continue to rely on the arguments made in their prior response filed July 9, 2003 and these arguments will not be repeated here for the sake of brevity.

The remarks here will be directed to the examiner's comments which were directed to the arguments made by applicants in the previous response.

A. The examiner has stated that Ercan et al. "... relates particularly but not exclusively to a method of selectively modifying pixel intensity information to improve legibility or visibility of parts of a digital image." Further, reference is made to Figs. 6A, 9A and 10A as illustrating missing information.

Ercan et al relates exclusively to improving legibility or visibility of a digital image. Nowhere, does the reference even remotely suggest recovering missing color data in a two-dimensional color array. Fig. 6A illustrates an enhanced 4-bit image of the license plate of Fig. 3 as processed according to Example 1; Fig. 9A illustrates the same license plate as processed in Example 2; and Fig. 10A illustrates the same license plate as processed in Example 3. In none of these instances is missing information recovered.

It should be noted here that applicants, in the previous response, stated that "Ercan et al relates to a black and white imaging method". This statement is not correct. Nevertheless, the distinctions pointed out by applicants with respect to the method of Ercan et al. are correct.

B. The examiner has stated that Ercan et al. in Fig. 5, illustrates a two-dimensional color array. This is not correct. The reference, at column 11, lines 9 - 10 states "Fig. 5 illustrates the mapping arrangement used in the above [example 1] example".

Subsequently, the examiner appears to have argued that example 5 of Ercan et al. illustrates a mapping arrangement wherein comparison of two images is carried out until the desired color image is obtained and that this process is the same as the method of applicants. Example 5 of this reference does not recover missing color data.

C. The examiner has stated that Heller et al (Fig. 6, step 84) illustrates that compensation pixel values are generated by examining the pixel values of the pixels surrounding the defective pixels. This may be so. However, it should also be noted that both embodiments of Heller et al use linear filters and there is no explicit teaching of the use of non-linear filters as are used in the method of applicants. Applicants' method involves the use of second color data and non-linear filters and the method of Heller et al does not. Applicants' method also

assumes that data is available at all pixels and therefore that defective pixels, such as are addressed by Heller et al do not exist or have been previously compensated.

D. The examiner has stated that it is the examiner's interpretation that "...correcting defective pixels on image sensing elements would have the same concept as correcting missing information pixels on image elements." It is submitted that this statement does not relate to the teaching of Heller et al.

The issue to be addressed is whether the rejection of the claims is proper based on the teaching(s) of the reference(s). Here it has been shown that Heller et al does not teach or suggest recovering missing color information.

E. The examiner has referred to the fact that Ercan et al refers, in the Abstract, to using a non-linear algorithm. This teaching is in the context of the overall method taught by the reference. As pointed out in detail, this reference does not teach recovering missing color information and the examiner has acknowledged this fact.

There is no suggestion in Ercan et al which would provide any incentive for one skilled in the art to take the reference to a non-linear algorithm out of the context of the overall teaching and incorporate a non-linear algorithm into the method of Heller et al. It is

impermissible to take from one reference only so much as is required to combine with another reference to arrive at the claimed invention. There must be some suggestion in the reference to do so. Here, since the respective methods of Ercan et al and Heller et al are directed to different results, there would be no suggestion to use a non-linear filter in the method of Heller et al. In fact, if a non-linear filter were to be used in the method of Heller et al the intended method would not be operative for its intended purpose.

In any event, even if, assuming *arguendo,* Ercan et al and Heller et al were to be combined in the manner suggested by the examiner, the combined disclosures do not amount to applicants' method. As has been discussed in detail, neither of the references involves the application of two one-dimensional non-linear interpolation processes.

F. With respect to claims 2 and 7, the examiner has stated that "Katayama on page 3 paragraph 0082, in a second embodiment teach correcting missing color on the image, and also see Fig. 31."

Paragraph 0082 of this reference states, with respect to a second embodiment that "...it is characterized by correcting a three-dimensional image on the basis of predetermined image sensing parameters or editing a three-dimensional image.". Nothing in this statement or the illustration shown in Fig. 31 deals with applicants' claimed method and apparatus directed to recovering

missing color data in a two-dimensional color array involving the application of two one-dimensional non-linear interpolation processes.

As discussed previously during prosecution, Katayama et al is directed to image sensing apparatus capable of placing an object, whose three dimensional shape is to be generated, under the optimum image sensing conditions upon sensing the object from a plurality of image sensing points. This reference is not directed to recovering missing color information.

In summary, applicants' claimed method and apparatus are directed to recovering missing color data in a two-dimensional color array. The method and apparatus involve the application of two one-dimensional non-linear interpolation processes. Generally speaking, applicants' method essentially "decouples" the conventional two-dimensional process into two one-dimensional processes. The first one-dimensional color recovery process generates intermediate second color image data from the sampled first color image data and the second one-dimensional color recovery process generates the desired third color image data from the second color image data.

As described in detail in the application (see, for example, page 8, line 28 to page 10, line 14) a two-dimensional array of discrete image sensing elements, each of which is specifically responsive to one of at least three predetermined colors (e.g., red, green and blue) is exposed to image information-bearing

illumination to obtain a collection of each electronic information signal received from each discrete element. The collection of signals forms the raw unprocessed one-color image data from which fully recovered third color image data can be derived.

The first step towards deriving the fully-recovered third color image data is to first recover missing color information along a first dimension (e.g., along rows of the array) by interpolating the first color image data along the first dimension to provide a first-interpolated color data for each of the discrete elements, forming a difference channel between the first color image data and the first interpolated color data and then applying a one-dimensional non-linear filter on the difference channel and combining with the first color data to obtain the first recovered image data. The second color image data comprises a combination of the first recovered image data and the first color image data.

The second step of the method derives fully-recovered third color image data from the two color image data by recovering missing color information along a second dimension, e.g., along columns of the array. The second color image data is obtained by interpolating along the second dimension to provide second interpolated data for each of the discrete elements, forming a difference channel between the second color image data and the second interpolated data and then applying a one dimensional non-linear filter on the difference channel

and combining with the second color data to obtain the second recovered image data. The third color image data comprises a combination of the second recovered image data and the second image data.

Here it is readily apparent that the teachings of the references cannot be combined to arrive at the claimed method and apparatus of applicants and therefore the disclosures of the references do not properly support the art rejections applied against claims 1, 3, 6 and 8.

Reconsideration of the art rejections applied to claims 1 -3 and 6 - 8, and withdrawal thereof are respectfully requested.

II. THE SECTION 112 REJECTIONS

Claims 3 - 5 and 8 - 10 have been rejected again under the first paragraph of 35 U.S.C. § 112 as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

A. The examiner has stated that claims 3 and 8 should specify the specifications and parameters for rank-order filters. It is further stated that it would be useful to overcome the rejection, for applicants to provide the assumptions for designing the non-linear filter, the formulation for the filter and the limitations of the filter.

The specification teaches that the filter functions to remove narrow peaks and valleys within the color difference data. See, for example, page 21, lines 26-28. It is also taught that a preferred non-linear filter is a median rank order filter (see, for example, page 14, lines 25 - 27). It is specified that a suitable rank order filter for use according to the claimed method and apparatus is described in United States Patent No. 4,802,108 which is incorporated by reference in the present application.

The function of a rank order filter on a set of values is to arrange the values in rank order, from smallest to largest, and then to select the value that occupies a specified rank in that order. For example, the "minimum" function is a rank order filter that selects the value that is the smallest (lowest in rank); the so-called "median" function is a rank order filter that selects the value of middle rank. For example, the median of the five numbers 1, 1, 5, 7, 2 is found by arranging the numbers in rank order, that is, 1, 1, 2, 5, 7 and then selecting the middle value which is 2.

It is known that rank order filters are valuable for removing localized impulses, or deviations, in a data stream. For example, the data sequence 0 0 1 2 1 1 0 15 0 1 2 1 0 1 1 is a stream with numbers typically between 0 and 2 but with an outlying value of 15 within it. If a median filter of length 3 were to be applied to this data stream the following results would be obtained

		Median
First 3 values	1, 2, 1	1
	2, 1, 1	1
	1, 1, 0	1
	1, 0, 15	1
	0, 15, 0	0
	15, 0, 1	1
	0, 1, 2	1
	1, 2, 1	1
	2, 1, 0	1
	1, 0, 1	1

and so forth.

The median filter has thus eliminated the outlying value. In a group of three numbers, the number 15 was always the largest and never the mean so it was never selected by the filter. In general, when the purpose of the rank order filter is to remove outlying values in a data stream, a median filter is a preferred choice since the outlying value will generally be the largest or the smallest value in any ranking and therefore will not be selected by the median filter.

The design parameters of rank order filters are: (a) the "length" of the filter, (i.e., the number of values for which the ranking is done); and (b) the rank order to be selected (i.e., lowest, middle, etc.). These parameters are tailored to the specific application. For example, in situations in which isolated outlying values are expected, a median filter of length 3 or greater may be selected because in this case each outlying value will be ranked along with at least 2 "normal" values and one of the normal values will be selected as the median.

When outlying values may occur in pairs, as may be the case in some of the color difference signals examples in the present application, then a median filter of length 5 or greater may be used. In this case, the two outlying values will always be ranked along with at least 3 "normal" values and one of the 3 normal values will be selected as the median.

The design considerations for rank order filters are known in the art and are taught, for example, in U.S. Patent 4,663,655 which has been cited as prior art in this application. The operation of rank order filtering may be exercised in software or hardware as described in U.S. Patent 4,802,108 (incorporated by reference herein) and the references cited therein.

Thus, in view of the teaching of the present specification, together with the state of the art with respect to rank order filters, as illustrated by the foregoing remarks and the cited patents and the journal articles submitted by applicants with their previous response, it is submitted that applicants clearly were in possession of the subject matter of claims 3 and 8 at the time the application was filed.

B. The examiner, regarding claims 4, 5, 9 and 10, has asked "How does Applicant consider a combination of red and green wavelengths, while there are other colors such as orange and yellow colors between the red and green wavelengths?"

The application teaches that three different predetermined colors are used and each discrete element is responsive to one of three different predetermined colors. Claims 4 and 9 recite that the three predetermined colors are a color substantially within the red wavelengths, a color substantially within the green wavelengths and a color substantially within the blue wavelengths. Claims 5 and 10 recite that the predetermined colors are a color substantially within a combination of red and green wavelengths, a color substantially within a combination of green and blue wavelengths and a color substantially the red and blue wavelengths.

Generally speaking, red wavelengths are in the vicinity of 650 nm, green wavelengths are in the vicinity of 550 nm and blue wavelengths are in the vicinity of 450 nm.

In the case of CCD imagers as utilized in the present invention, it is preferred to record color by placing a red, a green and a blue color filter over each pixel and to have a fraction of the pixels responsive to each of these primary colors. Thus, each pixel is responsive to a single one of the three primary colors.

It should be recognized that the present claims require the discrete elements to be responsive to the recited wavelengths. Each discrete element may be responsive to other wavelengths also. Thus, a discrete element may be responsive to wavelengths in the red

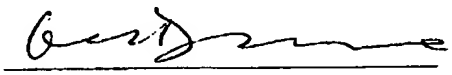
region and also to wavelengths in the orange and/or yellow regions.

Those skilled in the art are clearly familiar with the color principles embodied in the claimed subject matter. That there are orange and yellow colors in the spectrum between the red and green wavelengths does not render claims 4, 5, 9 and 10 defective under the first paragraph of Section 112. All that is required for the operation of the method is that each discrete element be responsive to one of three predetermined colors.

In view of the foregoing, it is submitted that applicants clearly were in possession of the subject matter recited in claims 3 - 5 and 7 - 10 at the time the application was filed. Accordingly, these claims comply with the criteria for patentability established by the first paragraph of 35 U.S.C. § 112.

Reconsideration of these grounds of rejection and withdrawal thereof are respectfully requested.

Respectfully submitted,



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